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GENETIC VARIABILITY AND INTER-RELATIONSHIP STUDIES IN BLACK SEEDED SESAME (*Sesamum indicum* L.)

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ABSTRACT

Studies on genetic variability, correlations and path coefficient analysis in 40 diverse genotypes of black seeded sesame revealed wide range of variability for plant height, branches per plant, seed yield and capsules per plant, high heritability for protein and oil content, days to maturity, days to flower; and high genetic advance for plant height, branches per plant, seed yield, days to flower, capsules per plant and protein content. Seed yield with capsules per plant, capsule length, capsule girth and seeds per capsule; and oil-content with days to flower and maturity, plant height and capsules per plant showed significant and positive genotypic correlations. Path coefficient analysis revealed days to maturity, branches per plant and copsule grith as major components for seed yield, and branches per plant, capsule grith and seeds per capsule as major conponents for oil content in black seeded sesame.

KEY WORDS : Sesame, Variability, Correlation.

Sesame is one of the most ancient among oilseed crops in the country. There are areas especially under tribal communities where black-seeded sesame varieties are preferred. For developing high yielding black seeded varieties, the present investigation was undertaken to colleet the basic information on genetic variability, correlations and path coefficient analysis in 40 diverse genotypes of black seeded sesame chosen from the germplasm maintained at Regional Station of Agricultural Research, Sumerpur, (Rajasthan). These information though available for sesame (Sanjeevaiah and Joshi, 1974, Trehan *et al.* 1975; Shukla and Verma, 1976 and Pathak and Dixit, 1986), are not available specific to black seeded sesame.

MATERIALS AND METHODS

The materials for the present study consisted of 40 black seeded diverse

Table 1 . Genetic variability for 11 Characters in black seeded Sesame

Character	Range	Mean	GCV	PCV	h^2(%)	G.A. as % of mean
Seed yield (g)	1.133-6.800	4.233	26.38	49.12	28.86	29.21
Days to flower	32.0-71.1	48.2	16.37	19.08	73.62	28.94
Days to maturity	75.8-105.9	89.2	8.46	9.71	76.00	15.20
Plant height (cm)	73.27-145.40	125.78	52.13	76.94	45.91	72.80
Branches/plant (no.)	0.40-8.60	5.24	32.98	53.42	38.11	41.94
Capsule/plant (no.)	32.1-83.5	55.1	22.89	41.34	30.66	26.11
Capsules length (cm)	2.40-3.07	2.70	3.40	7.11	22.76	3.34
Capsule girth (cm)	2.68-3.20	2.88	4.41	6.40	47.35	6.25
Seeds/capsule (no.)	57.9-76.9	66.7	4.57	8.46	29.17	5.08
Protein content (%)	20.1-29.5	24.4	10.59	10.64	99.07	21.71
Oil-content (%)	44.2-46.8	45.5	1.85	1.96	89.57	3.61

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Table 2. Genotypic (upper diagonal) and phenotypic (lower diagonal) correlation coefficients between different pairs of characters in black seeded sesame

Character	Seed yield	Days to flower	Days to maturity	Plant height	Branches/ plant	Capsules/ plant	Capsule length	Capsule girth	Seeds / capsules	Protein content	Oil content
Seed yield	-	-0.245*	-0.265*	-0.169	0.093	0.752**	0.680**	0.519**	0.521**	0.018	-0.393**
Days to flower	-0.115	-	0.961*	0.088	0.340**	-0.382**	-0.378**	-0.167	0.319**	-0.109	0.303**
Days to maturity	-0.134	0.799**	-	0.035	0.173	-0.383**	-0.130	0.086	0.548**	-0.119	0.309**
Plant height	-0.048	0.085	0.032	-	-0.030	-0.243*	-0.564**	-0.0921	-0.368**	-0.291**	0.279*
Branches / plant	0.264*	0.164	0.070	-0.037	-	0.644**	-0.424**	-0.488**	-0.283*	-0.023	0.016
Capsules / plant	0.516**	-0.158	-0.175	-0.115	0.705**	-	0.196	0.126	-0.065	0.138	0.256*
Capsule length	0.142	-0.173	-0.024	-0.130	-0.243*	-0.028	-	0.718**	0.723**	0.258*	-0.463**
Capsule girth	0.211	-0.206	0.009	-0.008	-0.256*	-0.037	0.499**	-	0.579**	0.052	-0.103
Seeds / Capsule	0.075	0.162	0.248*	-0.044	-0.230	-0.107	0.596**	0.499**	-	0.355**	-0.440**
Protein content	0.011	-0.099	-0.114	-0.205	-0.002	0.088	0.126	.049	0.206	-	-0.602**
Oil content	-0.62	0.248*	0.262*	0.196	0.024	0.123	-0.196	-0.080	-0.237*	-0.569**	-

*P = 0.05

**P = 0.01

Table 3. Direct and Indirect effects of different characters for seed yield in black, seeded ses...me

Character	Effects via										'rg' with seed yield
	Days to flower	Days to maturity	Plant height	Branches/ plant	Capsules/ plant	Capsule length	Capsule girth	Seeds / capsule	Protein content	Oil content	
Days to flower	-9.855	8.840	-0.065	0.692	0.470	0.659	-0.147	-0.346	0.019	-0.511	-0.245*
Days to maturity	-9.469	9.200	-0.026	0.351	0.471	0.227	0.076	-0.596	0.021	-0.529	-0.265*
Plant height	-0.869	0.318	-0.740	-0.062	0.299	0.984	-0.080	0.401	0.052	-0.471	-0.169
Branches / plant	-3.353	1.587	0.022	2.034	-0.792	0.739	-0.429	0.308	0.004	-0.028	0.093
Capsules / plant	3.769	-3.524	0.180	1.310	-1.229	-0/341	0.111	-0.071	-0.024	0.431	0.752*
Capsule length	3.724	-1.196	0.418	-0.862	-0.241	-1.744	0.632	-0.787	-0.046	0.780	0.680*
Capsule girth	1.643	0.791	0.068	-0.992	-0.154	-1.252	0.881	-0.630	-0.009	0.173	0.519*
Seeds / Capsule	-3.139	5.044	0.273	-0.576	0.080	-1.261	0.509	-1.088	-0.063	0.741	0.521**
Protein content	1.069	-1.098	0.215	-0.047	-0.169	-0.449	0.046	-0.386	-0.177	1.015	-0.018
Oil content	-2.989	2.838	-0.207	0.033	0.314	0.807	-0.090	0.478	0.107	-1.685	-0.393**

Residual effect = 0.506
(The underlined figures denote the direct effects.)

Table 4. Direct and indirect effects of different characters for oil-content in black, seeded sesame

Character	Effects via										'rg' with seed yield
	Seed yield	Days to flower	Days to maturity	Plant height	Branches/ plant	Capsules/ plant	Capsule length	Capsule girth	Seeds / capsule	Protein content	
Seed yield	-0.336	-0.003	0.124	0.053	0.041	-0.261	-0.616	0.417	0.201	-0.012	-0.393**
Days to flower	0.062	0.013	-0.448	-0.028	0.150	0.133	0.342	-0.134	0.123	0.068	0.303*
Days to maturity	0.089	0.013	-0.466	-0.011	0.076	0.133	0.118	0.069	0.212	0.075	0.309*
Plant height	0.057	-0.001	-0.016	-0.312	-0.013	0.085	0.511	-0.073	-0.142	0.183	0.279*
Branches / plant	-0.031	0.005	-0.080	0.009	0.441	-0.224	0.384	-0.392	-0.109	0.015	0.016
Capsules / plant	-0.253	-0.005	0.178	0.076	0.284	-0.348	-0.177	0.101	-0.025	-0.087	-0.256*
Capsule length	-0.229	-0.005	0.061	0.176	-0.187	-0.068	-0.905	0.577	0.280	-0.162	-0.463**
Capsule girth	-0.175	-0.002	-0.040	0.028	-0.215	-0.044	-0.650	0.804	0.224	-0.033	-0.103
Seeds / Capsule	-0.175	0.004	-0.255	0.115	-0.125	0.023	-0.655	0.465	0.387	-0.223	-0.440**
Protein content	-0.006	-0.001	0.056	0.091	-0.010	-0.048	-0.233	0.042	0.137	-0.628	-0.602**

N.B. : The residual effect = 0.473
(The underlined figures denote the direct effects.)

genotypes of sesame grown in a RBD with four replications during Kharif, 1974. The plot size was of single row of 10 m lengh, the spacing adopted being 30 cm X 15 cm. Five plants were randomly chosen from each genetype in each replication for observation. The composity sample of each genotype from each replicaion was used for protein and oil-analysis. The mean values were analyzed. Genetic coefficient of variation was calculated according to Burton (1951), heritability in broad sense according to Johnson *et al.* (1955) whereas path coefficients were estimated as per the procedure given by Dewey and Lu (1959).

RESULTS AND DISCUSSION

The results are presented in Tables 1 to 4. The data revealed the wide range of variability for all characters except capsule length and girth, protein and oil content as evidenced by range. High genetypic coefficient of variability (GCV) and phenotypic coefficient of variability (PCV) were ibserved for plant height, number of branches, seed yield and capsule number, whereas moderate values for days to flower and protein content. Higher estimates of heritability and moderately higher genetic advance expressed as percentage of mean were observed for protein and oil-content, and days to flower and maturity. Plant height, capsule number and number of branches showed moderate heritability and higher mangnitude of genetic advance expressed as percentage of mean whereas capsule length and seeds per capsule revealed low heritability and low genetic advance. High heritability followed by high genetic advance expressed as percentage of mean shows the most effective condition for selection as was observed for protein content, days to flower and plant height. This condition appears t be due to additive gene action. Oil-content showed very high heritability but very low magnitude of genetic advance which might be due to non-additive gene action i.e. dominance and epistasis (Liang and Walter, 1968). The results obtained under the present investigation are in conformity to those of Debral and Molker (1971), Murugesan *et al.* (1979) and Pathak and Dixit (1986).

The results revealed that the genotypic and phenotypic correlations followed the same trend and that the genetypic correlations were generally higher than the phenotypic correlations (Table 2).

Seed yield was strongly and positively correlated with branches and capsules per plant at phenotypic and capsule number, capsule length, capsule girth and seeds per capsule at genetypec levels. However, seed yield showed significant negative correlation with days to flower and maturity and oil-content. Days to flower with days to maturity, branches per plant, seeds per capsule and oil- content, and days to maturity with seeds per capsule and oil content showed significant positive correlations at genetypic level revealing the role of additive gene action. These two characters gave strong negative correlation with capsules per plant at genetypic level. Plant height and capsules per plant with oil-content, capsule length with capsule girth; seeds per capsule and protein content; capsule girth with seeds per capsule; and seeds per capsule with protein content also showed strong positive correlation, generally at genetypic levels. It was futher observed that plant height with capsules per plant, capsule length, capsule girth, seeds per capsule and protein content; branches per plant with capsule length, capsule girth and seeds per capsule; capsule length, seeds per capsule and protein content with oil-content exhibited significant negative correlations. The results on correlaction obtained under the present study are generally in conformity, to those of Sanjeevaiah and Joshi (1974) Shukla and Verma (1976) and Pathak and Dixit (1986). These studies clearly indicate that nature of correlations especially for important characters in sesame do not change across the seed colour or plant types.

The data on path coefficient analysis for seed yield (Table 3) revealed that days to meturity followed by branches per plant and capsule grith appears to be important yield components. It is pertinent to note that days to maturity which had negative genotypic correlations gave the highest direct positive effects. On the contrary, the characters *viz.* capsule number, capsule length and seeds per capsule which had highly significant positive genotypic correclations gave negative direct effects. Days to flower *via* days to maturity; capsules per plant, capsule length and capsule girth *via* days to flower; seeds per capsule *via* days to maturity; protein content *via* days to flower and oil-content, whereas oil-content *via* days to maturity contribed high posity indirect effects. Pathak and Dixit (1986) had reported days to flowering, plant height, capsule length, seeds per capsule and 100-seed weight as the major components of seed yield in single stemmed sesame, which do not conform to the results obtained under the present investigation.

For oil-content, the capsule girth, branches per plant and seeds per capsule appear to be the major components (Table 4). The direct effects of seed yield, days to maturity, plant height, capsules per plant, capsule length and protein content were negative. It was found that seed yield, capsule length and seeds per capsule *via* capsule girth; days to flower and plant height *via* capsule length; capsules per plant *via* brainches per plant; and protein content *via* seeds per capsule gave high positive indirect effects. Negative correlation and negative direct effect of protein content suggested no posibility for concurrent selection for higher oil and protein content.

The study indicated that sufficient genetic variability exists for majority of the characters under study and the high heritability followed by higher magnitude of genetic advance obtainted for those characters indicate the possibility of their imporvement through selection. The significant negative correlation of seed yield with days to flower and maturity revealed the possibility of evolving early maturning high yielding genetypes; however, the highest direct positive effect of days to maturity indicated that it may not be desirable to evolve very early genotypes in black seeded sesame. The negative correlation between seed yield and oil-content, and negative direct effect of oil-content on seed yield and *vice-versa* indicated that a compromise must be made between oil-content and seed yield while making selection for those two characters simultanecusly. The path coefficient analysis indicated days to maturity, branches per plant and capsule girth of seed yield; and branches per plant, capsule girth and seeds per capsule of oil-content, as the major components. However, the indirect comtribution of other character *viz.* plant height, capsules per plant and seeds per capsule may also be taken into account along with major compoments while suggesting the reliable selection indices for seed yield and oil-content in black seeded sesame.

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EVALUATION OF AN IRRIGATION MODULE THAT CLAIMS CONSTANT DISCHARGE

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ABSTRACT

Flow measurement forms the backbons of water management. From time to time, devices are evalved for flow measurement and irrigation module is one such expedient. It is claimed of a particular irrigation module that it can maintain a constant discharge irrespective of the depth of flow. To test verify this claim, experiments were carried on two such modules - 3 lit/sec and 6 lit/sec capacities. It has been decisively arrived that the modules do not pass a constant discharge. Instead, the discharges passed through, seem to vary more or less in a linear way causing percentage deviations even to the extent of 108%.

KEY WORDS : Irrigation Module, Free flow, Submerged flow, Discharge.

For efficient water management in agriculture, water needs to be metered. Weirs, watermeters, venturimenters have all become recognised devices to measure the flow. Of these, weirs have assumed for more importance in measurement of flow due to the fact that they are suited to measure flow in open channels and they are simple to operate without involving any sophistication. These weirs discharge constant flows only under the constancy of heads over the notch. If the head over the weir varies over a duration, then the total discharge may be found by knowing the head values at different times and then finding the corresponding discharges and